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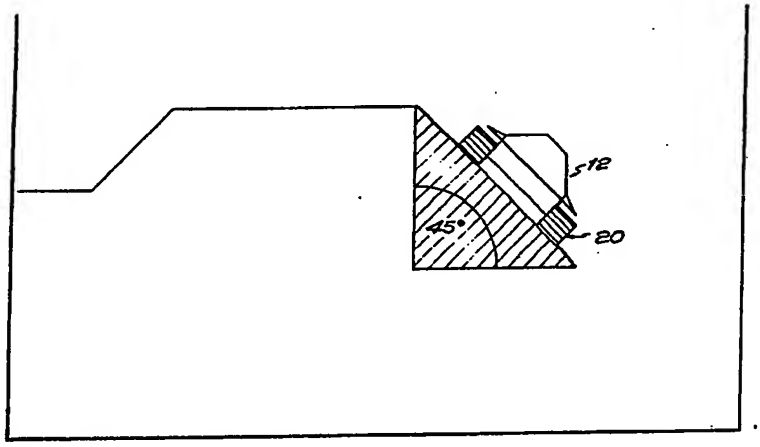

(57) Abstract

The present invention provides an all terrain vehicle with an agricultural or handling implement mounted on the front of same. The vehicle is designed so as to be stable and maintain traction when operating on slopes of at least up to 45° and preferably up to 60°. The implement is power operated from the vehicle prime mover and the vehicle preferably is capable of remote control or can be controlled by a driver for whom a self levelling seat is provided. Hydrostatic transmission is used for driving the side wheels of the vehicle so that each wheel is driven and the wheels at respective sides can be driven differentially for the steering of the vehicle.

* See back f page

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Improvements Relating to Vehicles

The present invention relates to vehicles.

Large agricultural implements such as grass cutters, hedge trimmers, ploughs and harrows are used throughout the world and are in general connected to tractors. However, although tractors can work on rough terrain if it is relatively flat, they cannot operate on steep slopes because of their instability which is largely due to their high centre of gravity. A tractor working on a steep slope is liable to overturn injuring or killing the driver. In the past therefore it has been impossible to use mechanised methods for carrying out certain tasks, for example the cutting of grass on steep embankments such as those bordering roads or railway lines, or grassy banks on golf courses.

A further disadvantage of the use of tractors for the driving of agricultural machinery is their relative lack of manoeuvrability which makes it impossible for them to operate in small spaces. In the past therefore, many tasks have had to be carried out manually which, but for these disadvantages, could have been mechanised.

The present invention seeks to overcome these disadvantages by providing that an all terrain vehicle which has a low centre of gravity and therefore can operate and maintain traction on surfaces sloping at an angle to the horizontal of at least up to 45° and preferably up to 60°, is provided with an agricultural or handling implement.

The implement preferably is mounted on the front of the vehicle by mounting means.

Said mounting means preferably is such as to enable the

implement to be raised and lowered selectively. Preferably, the implement is carried by two arms pivotably mounted at the rear of the vehicle, the implement being rigid with the arms, but able to float relative to the ground.

The vehicle may be operated by a driver present on the vehicle, or, in a particularly advantageous arrangement, by remote control; or by a combination of both methods. In some cases, there will be no provision for any driver whatsoever. In the case of vehicles which can be operated manually, a self-levelling seat may be provided. The provision of an all terrain vehicle with a self-levelling seat for the driver in itself constitutes an aspect of this invention.

The vehicle may have six or four wheels and is preferably equipped with an all wheel drive comprising a motor for each wheel. Each motor preferably is a hydraulic motor supplied with hydraulic fluid from suitable pump means, such as a variable displacement pump, the pump means being powered by an internal combustion engine. By using hydraulics, the drive may be infinitely variable. A pressure relief valve is preferably included in the hydraulic system to regulate the pressure across each motor to a safe level.

The hydraulic motors are preferably arranged in two independent drive trains, one at each side of the vehicle. A manually and/or remotely operated steering wheel directional valve serves to vary the flow of oil to each drive train.

Each drive train may be driven in forwards or reverse direction and preferably the two drive trains can be contra-rotated in order to turn the vehicle about its centre. The vehicle can also be skid steered.

Th agricultural implement may also driven by the engine and is preferably connected to the front of the vehicle. The engine preferably has sufficient power to be able to fulfill the maximum power requirements of both the vehicle and the agricultural implement. The implement preferably is a flail mower driven by a hydraulic motor in turn driven by a fixed delivery gear pump from the engine.

The remote control link, when provided, may use an infrared beam and is preferably via pulsed position modulated transmission wherein the timed pulses are part of a digitally coded signal which is generated and decoded by computer. Operation via the remote control link may provide total directional control of the vehicle and any necessary control of the agricultural implement. As an alternative radio control may be used.

The invention will now be further described with reference to the accompanying diagrammatic drawings in which:-

Fig. 1 is a rear view of an all terrain vehicle in operation on a 45^{o} slope;

Fig. 2 is a side view of a grass cutter connected thereto;
Fig. 3 is a rear view of the all terrain vehicle; and

Figs. 4A and 4B are a side view and end view respectively of an alternative embodiment of the assembly of grass cutter connected to an all terrain vehicle;

Fig. 5 is a diagrammatic plan view of the drive of the all terrain vehicle; and

Fig. 6 is a mor detailed view of the hydraulic current of

the vehicle of Figs. 1 to 3 and Figs. 4A and 4B.

As shown in Figs. 2 and 4A, an agricultural implement, in this case a grass cutter 10 of the rotary flail type is connected to the front end of an all terrain vehicle 12. The vehicle is powered by an internal combustion engine 14 which must be sufficiently powerful to drive both the vehicle 12 and the grass cutter 10. A suitable engine would be, for example, a four-cylinder turbo charged direct injection engine which is air-cooled and has a power output of 100 horse-power, 2,000 rpm or a twin cylinder diesel engine developing 45 HP at 2800 rpm. The engine should also have a deep oil sump to enable it to operate on steep slopes.

The engine 14 is connected to an oil pump 16 via an infinitely variable transmission system and the oil pump supplies oil to six hydraulic motors 18, one of which is mounted on each of the wheels 20 so that the vehicle has permanent all-wheel drive. The motors 18 are arranged in two drive trains 21, 22, (Figs. 5 and 6) one at each side of the vehicle 12 and each of the drive trains 21, 22 is independently controlled but the motors of each train rotate in the same direction and at the same speed.

When the vehicle is operated manually or remotely, it is steered by means of steering wheel directional valves 17 which control and vary the flow of oil to the two drive trains and thus changes the speed of the wheels on one side of the vehicle with respect to the wheels on the other side of the vehicle forcing the vehicle to turn. Each of the steering valves has twin service ports and is pressure compensated enabling it to regulate the flow through the service ports. The ratio of oil flow to one drive train and oil flow to the other drive train varies between 10:90 and 90:10.

Each set of whe ls can be driven in either a forward or a reverse direction and, in order to give the vehicle the ability to turn about its centre, it is possible to contra-rotate the wheels. The wheels of the all terrain vehicle are relatively small compared with the rear wheels of a tractor; a typical wheel diameter is 24 inches. This allows the chassis and thus the centre of gravity of the vehicle to be closer to the ground than in a tractor and the stability of the all terrain vehicle is thus greatly increased over that of a tractor. A grass cutter connected to such a vehicle can operate parallel to a slope of 60^{o} which is the maximum found for example on an embankment of a road or a railway cutting.

The implement may be adapted to be moved between a raised inoperative position and a lowered working position as shown in the drawings. The movement of the implement may be controlled either manually or automatically in the same manner as the control of the steering of the vehicle. The implement preferably is adapted to "float" in the in use position, and its movement is damped by hydraulic means. Thus hydraulic rams may be used for raising the implement by supplying fluid pressure only to one side of the rams to lift the implement, and for the lowering of the implement the hydraulic fluid is simply exhausted allowing the implement to fall under gravity. Using rams in this way also enables the rams to be used as hydraulic dampers. Other implements or handling apparatus may be provided.

Mounted to the chassis is a seat which is equipped with a self levelling device which enables a driver to operate the grass cutter on a slope whilst experiencing the minimum discomfort. If the slope becomes too steep for comfort, then the driver can dismount and operate the grass cutter and

vehicle by remote control. In the vehicle of Figs. 4A and 4B there is no provision for accommodating a driver whatsoever.

When the apparatus is operated by remote control, an infra-red sensor 19 a radio receiver mounted on the vehicle receives a pulsed position modulated transmission comprising timed pulses which are part of a digitally coded signal which is generated and decoded by computer. Operation by the remote control link will provide control of engine speed and total directional control of the vehicle, in addition to control of any desired function of the grass cutter. The apparatus can be remotely operated from a distance of up to 150 metres. The engine may be provided with an electric shut down solenoid which is permanently energised in the engine run position. This arrangement ensures that if there is electrical failure, the vehicle will stop by dropping out of the electric shut down solenoid. The electrically operated throttle control for controlling engine speed which is adapted to be remotely operated is arranged so that it can also be operated by a switch sited at the ignition panel of the vehicle.

An all terrain vehicle is exceptionally stable because of its low centre of gravity, and it can be manoeuvred with ease in small spaces and even turned on its axis and, when necessary, can be operated by remote control, and the combination of same with an agricultural implement or handling implement such as a log handling implement makes for a particularly advantageous machine. The use of such equipment enables machinery to be used in many situations where formerly tasks had to be done manually or using hand operated machines.

Figure 2 shows the vehicle with a drivers cabin whilst in Figure 5 the vehicle has no provision for a driver and is

remotely controlled only.

Referring now to Fig. 6 which shows the hydraulic circuit in slightly more detail, the engine 14 is shown, and it is drivingly connected to the variable displacement pump 16 which is capable of delivering an infinitely variable output flow. The pump draws oil from a tank 50 and is connected to a drain tank 52 for discharge. The output from the pump 54 has a pressure relief valve 56 connected thereto, and the output 54 is split between two supply lines 58, 60 by means of a flow divider 62. The output lines 58 and 60 pass through the steering control valves 64, 66 of the respective motor trains 21 and 22. It will be understood that each valve 64, 66 has two positions. In the position shown in Fig. 6 each valve is returning the output flow in line 58 and 60 to a return tank 68, but each valve 64 and 66 can be positioned so that flow on output line 58 or 60 passes to supply line 70 and 72 of the respective motors 18 for driving same in a first direction, say a forwards direction, and lines 74 and 76 in such position form return lines for the returning fluid from the motors 18.

In yet a third position of the valves 64 and 66, the direction of flow of pressure fluid in lines 70 and 74 in the case of train 21 and 72 and 76 in the case of train 22 can be reversed causing the direction of rotation of the motors to be reversed. The vehicle can therefore be driven in forwards or reverse direction by controlling the valves 64 and 66. Equally, by controlling the valves 64 and 66 the motors of train 21 can be driven in the opposite direction from those in train 22 and by virtue of the flow divider 62 the motors in one train 21 can be driven faster in the same direction as those in train 22 and vice versa. By controlling the hydraulic circuit therefore the drive to the vehicle can b varied widely to give a complete steering

facility.

The circuit also embodies over centre valve 78 bridging the respective line pairs 70, 74 and 72, 76 and cross line relief valves 80 bridge the individual motors 18.

Modifications of the embodiments described may be made. For example the vehicle preferably is provided with parking brakes, which may be wheel mounted or fitted elsewhere on the vehicle. Also, the vehicle may be provided with roll-over protection means such as roll bars so that should the vehicle roll over, it will be protected by said roll-over means. Also instead of the implement being a rotary flail type mower it may be a rotary cutter as shown.

Although the vehicle is remotely controlled, it is preferable that the remote controller should have only a limited range of operation, and typically that range would be in the order of 30 metres, the vehicle being adapted stop automatically if it travels out of range.

CLAIMS

1. An all terrain vehicle which has a low centre of gravity and therefore can operate and maintain traction on surfaces sloping at an angle to the horizontal of at least up to 45° and preferably up to 60°, said vehicle being provided with an agricultural or handling implement.

2. A vehicle according to Claim 1, wherein the implement is mounted on the front of the vehicle by mounting means.

3. A vehicle according to Claim 2, wherein said mounting means is such as to enable the implement to be raised and lowered selectively.

4. A vehicle according to any preceding claim, wherein the vehicle is adapted to be operated by a driver.

5. A vehicle according to Claim 4, wherein the vehicle has a driver seat mounted on a self-levelling device.

6. A vehicle according to any preceding claim, wherein the vehicle is controllable by remote control to control at least vehicle speed and steering.

7. A vehicle according to any preceding claim, wherein the vehicle has two sets of side wheels, the wheels of each set being adapted to be driven at the same speed and in unison.

8. A vehicle according to Claim 7, wherein the respective sets of wheels can be driven differentially in the same direction or in opposite directions for the steering and turning of the vehicle.

9. A vehicle according to Claim 7 or 8, wherein each wheel

is driven by its own hydraulic motor.

10. A vehicle according to Claim 7, 8 or 9, wherein there are two or three wheels in each of said sets of wheels.

11. A vehicle according to any preceding claim, wherein the implement is power driven via a power transmission from the vehicle.

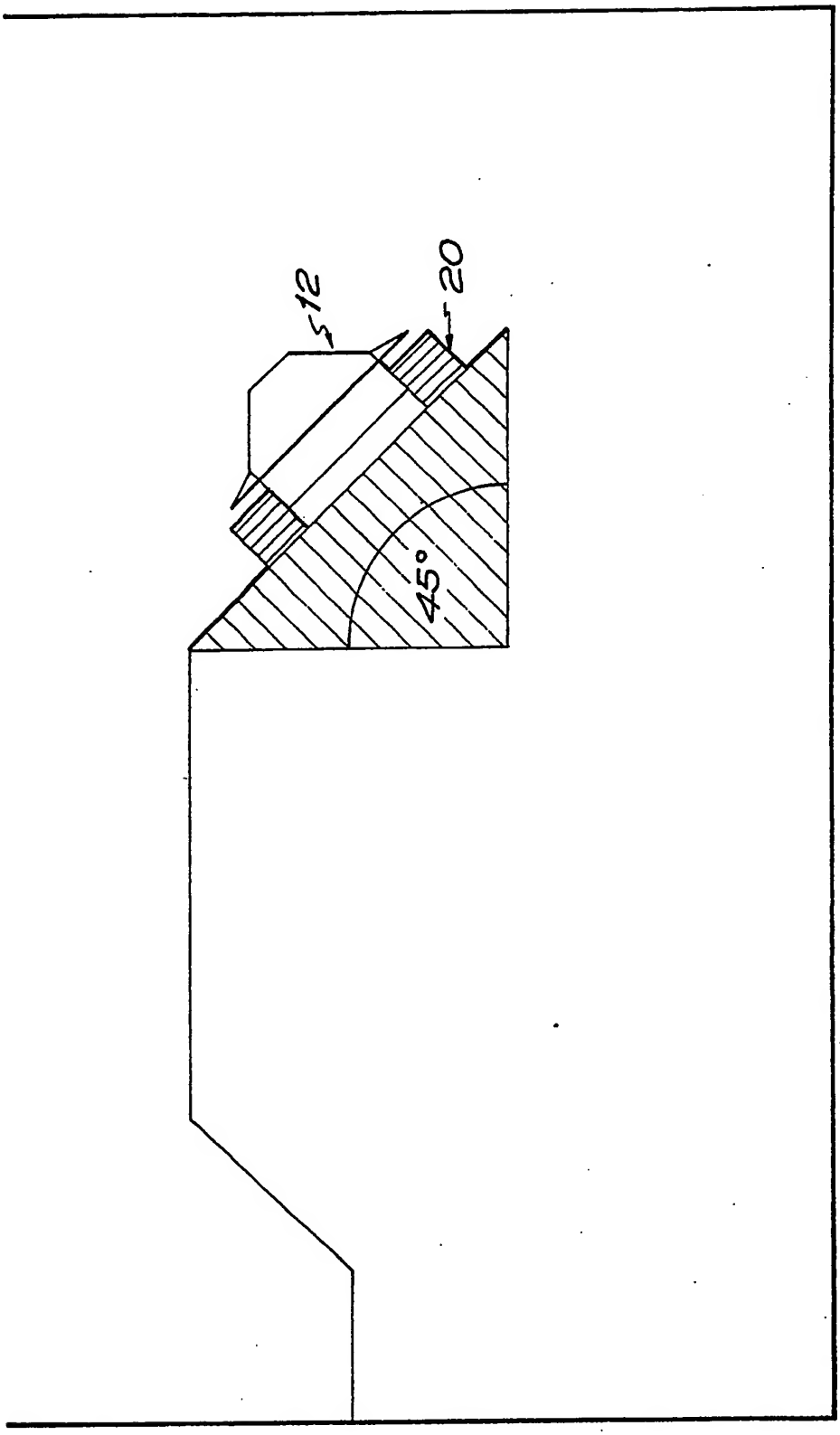

FIG.1

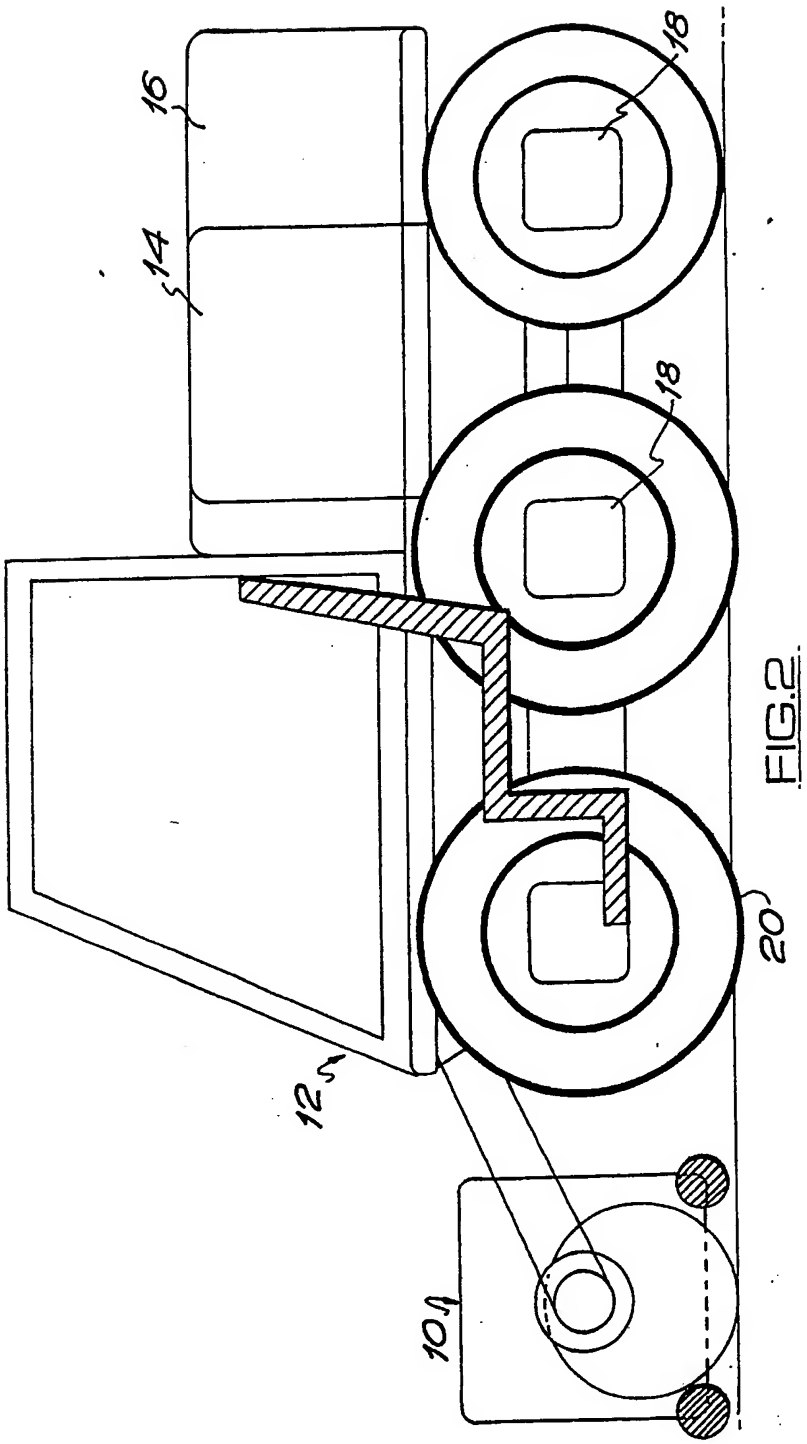

FIG.2

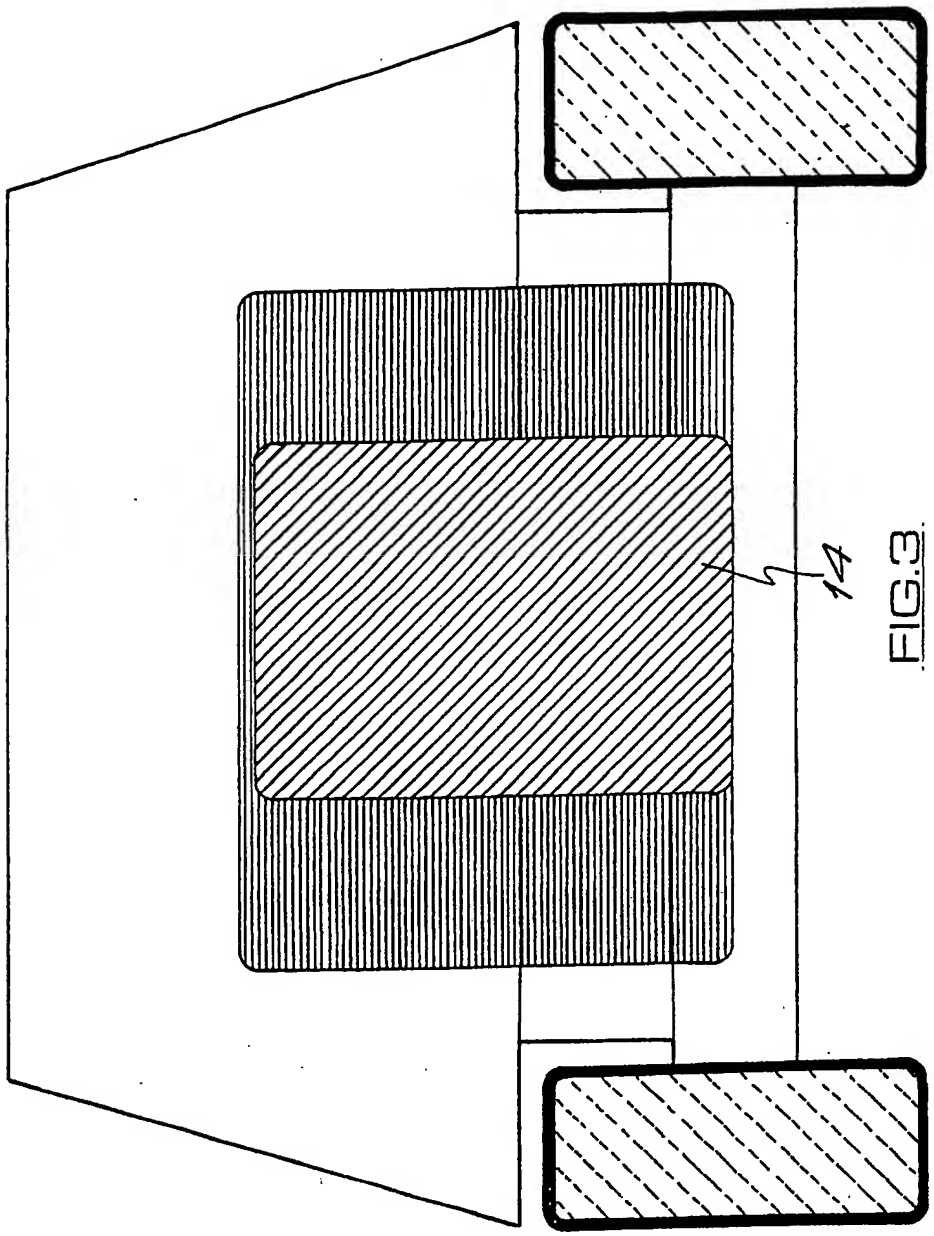

FIG.3

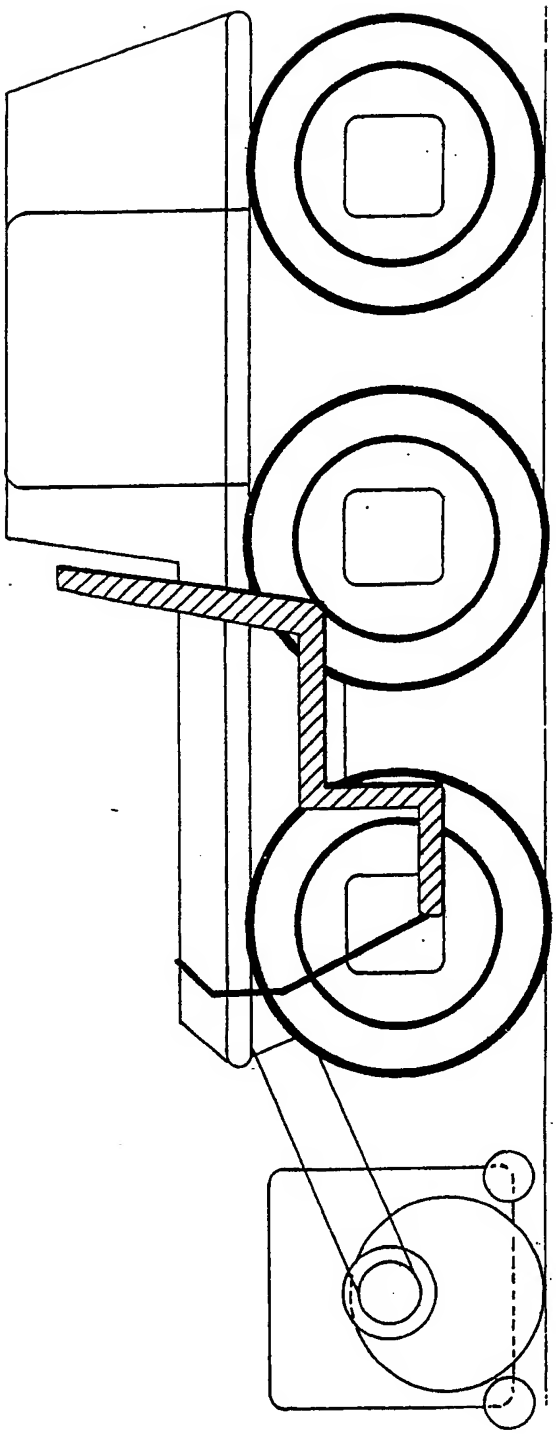

FIG.4.

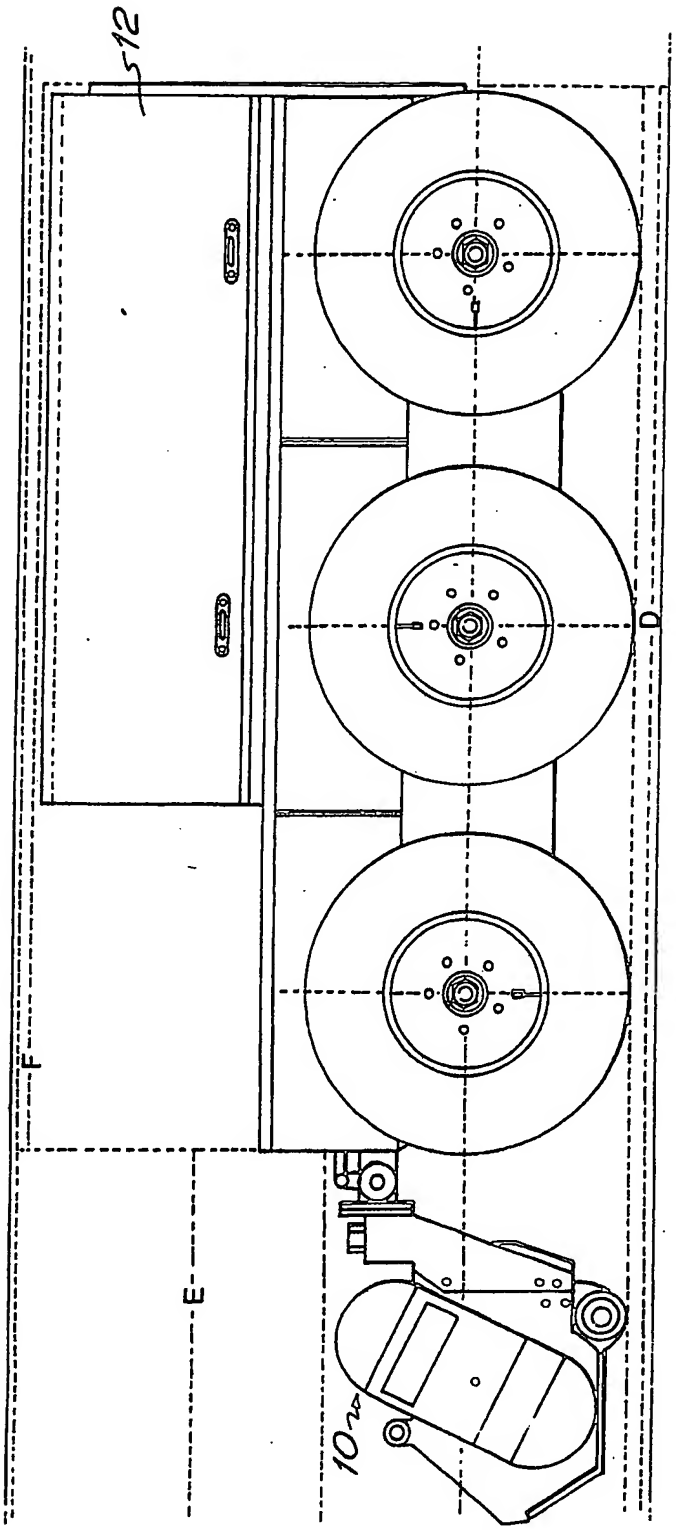

FIG.4A

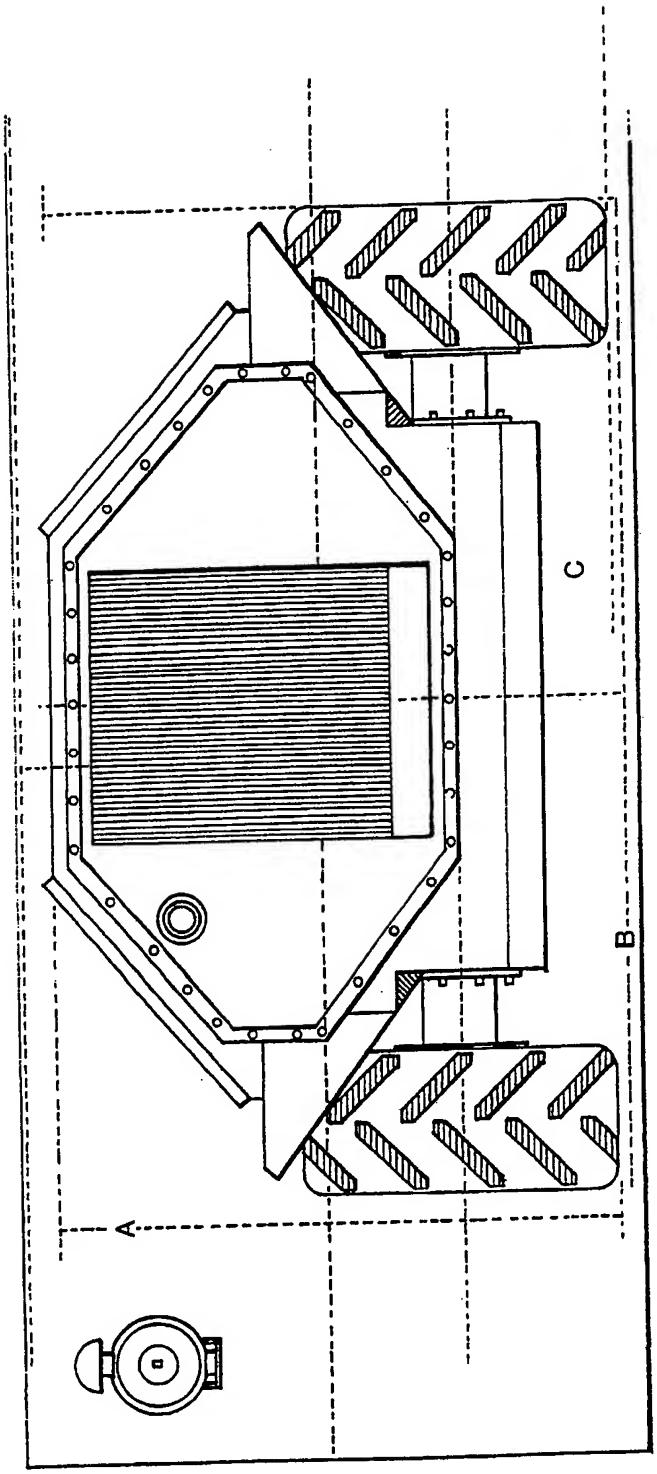

FIG.4B

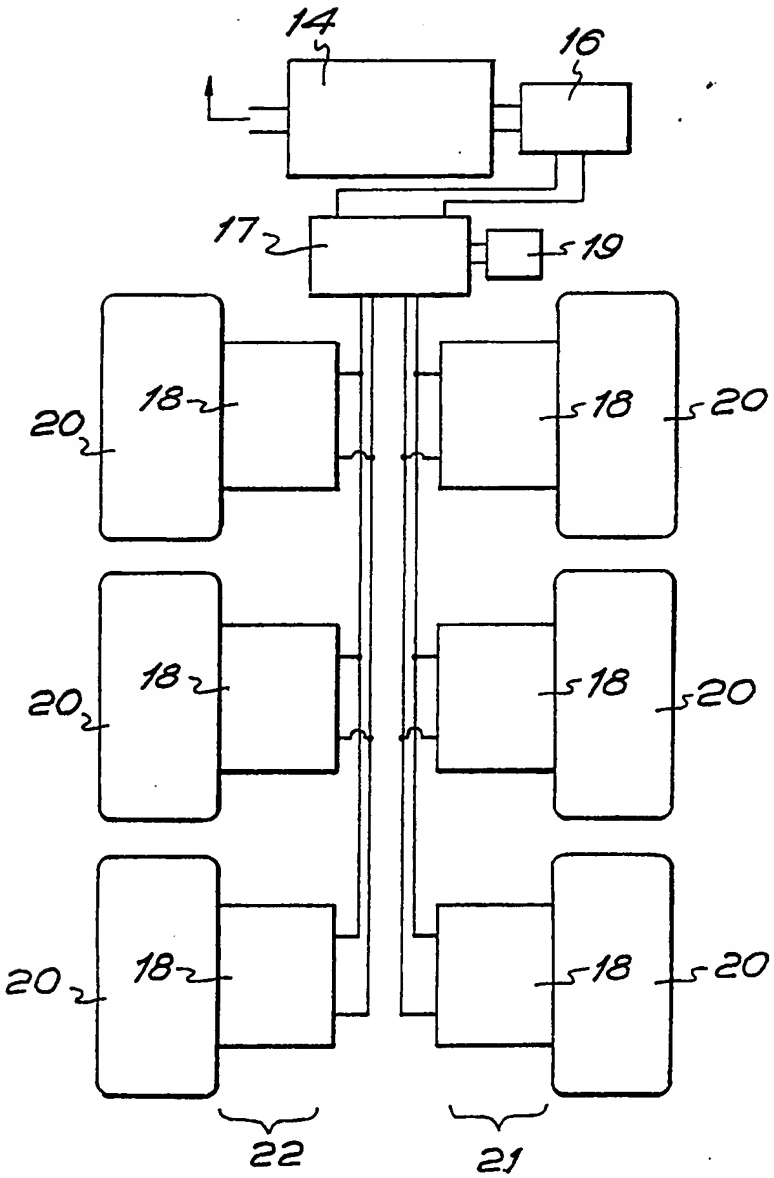

FIG.5

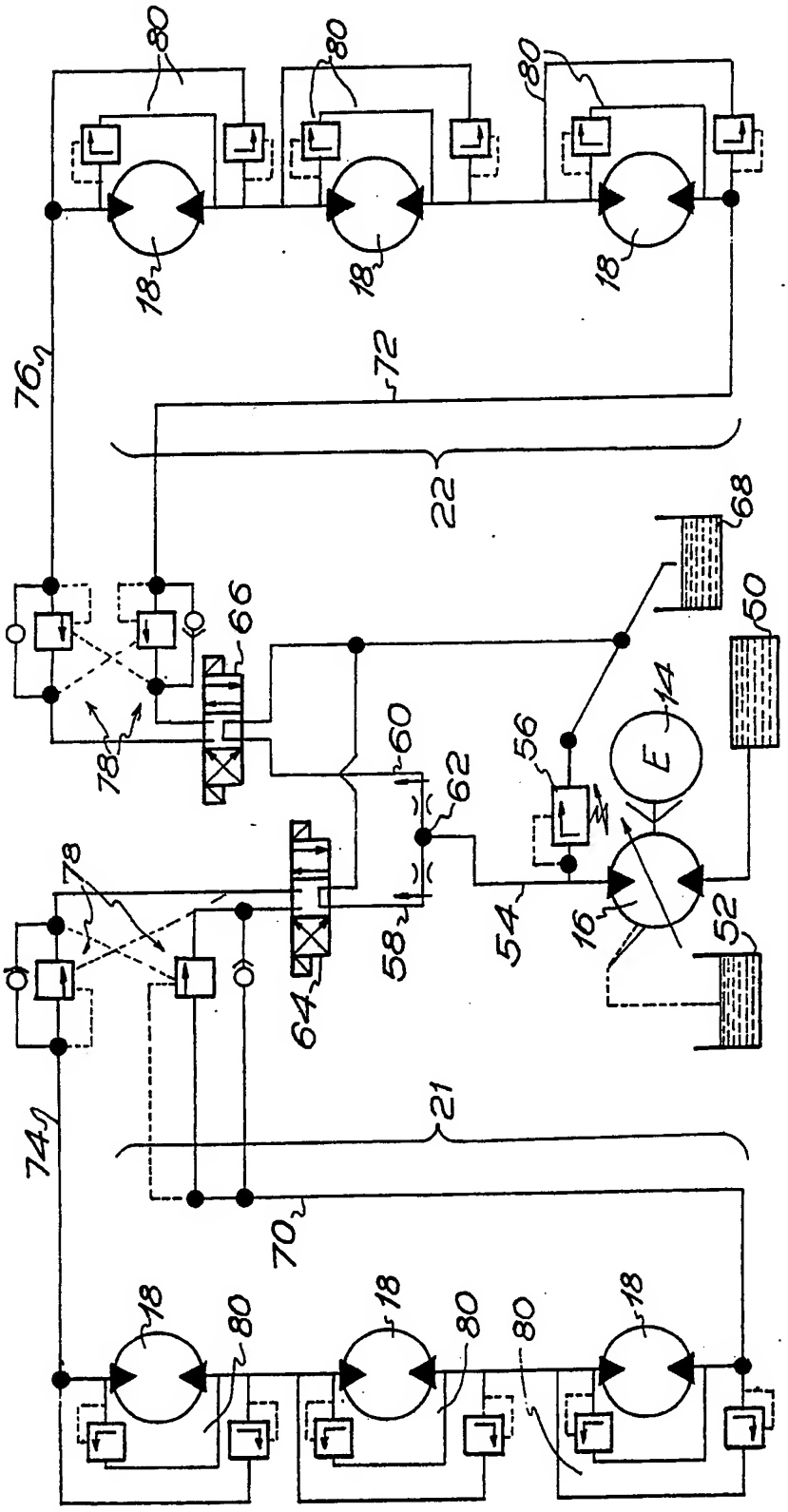
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FIG.6

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01090

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: B 62 D 49/08, B 62 D 61/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	B 62 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	WO, A, 89/00928 (KARLIN) 9 February 1989 see abstract; figures 1,6,7,10; page 1, lines - 13; page 3, line 20 - page 4, line 14; page 6, lines 30-35; page 8, lines 3-7; page 14, lines 16-22	1-4,5,11
X	DE, A, 3632416 (SCHAEFF) 7 April 1988 see abstract; page 3, lines 35-42, 63-68	1
X	US, A, 3792748 (REGIER) 19 February 1974 see abstract; figures 1,4,5; column 1, lines 42-60; column 2, lines 56-60; column 3, lines 37-61; column 6, lines 49-52	1-5,7-9,11

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
8th November 1990	-3 DEC 1990
International Searching Authority: EUROPEAN PATENT OFFICE	Signature of Authorized Officer: CZYK

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Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB, A, 2029784 (CARRUTHERS et al.) 26 March 1980 see abstract --	1,8,9,10
A	EP, A, 0161666 (STANDARD MANUFACTURING CO.) 21 November 1985 see figures 1,38 --	1,9
A	Automotive Engineer, vol. 9, no. 6, December 1984, (Southend-on-Sea, GB), D. Crolla: "Off-highway vehicle analysis", page 33, see especially paragraph: "Safety on slopes"	1,6

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9001090 SA 38437

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 23/11/90
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DE-A- 3632416	07-04-88	None	
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